VEHICLE SUSPENSION

The invention relates to a commercial vehicle, in particular a field tractor, with a single wheel suspension for unarticulated wheels.

Conventional field tractors with unsprung wheels no longer meet the demands for higher travel speed in road traffic, greater efficiency and economic soil conditioning in field operation whilst at the same time providing the best possible driving comfort. One precondition for achieving this is a vehicle suspension with the lowest possible unsprung mass. Field tractors with a rigid axle body between the wheels, as described in DE 201 06 172 Ul and EP 0 494 286 Bi, are poorly suited for meeting the requirements mentioned because of the high mass compared to that of the wheels. Moreover, the fact that the rear axle, uncoupled from the gearbox, is driven by a cardan shaft which departs from the vehicle gear, gives rise to a larger wheelbase which in turn results in a larger turning circle, thereby reducing the maneuverability of the vehicle. In the light of this it would appear appropriate, in the case of field tractors, to dispense with a rigid axle, at least in the rear area, and to adopt a single wheel suspension of the wheels.

Independent suspension for the wheels of field tractors is known. For example, a sprung support for the driven wheels of such vehicles is described in DE-PS 484 *552:* A wheel shaft departing from a universal joint in the gearbox extends through an axle housing secured to the side of the gearbox and supports a wheel at its free end. In the region of the wheel the axle housing passes into a vertical, arch-shaped guide in which a bearing, also arch-shaped and supported on the wheel joint, is guided so that the wheel shaft, with the wheel, is able to swivel

about the universal shaft against the force of leaf springs in the manner of transverse swinging arm. This design is relatively complicated.

A further independent suspension for wheels of field tractors, in which a wheel support is guided by means of several transverse swinging arms, was presented by the company John Deere at AGRITECHTNICA, which was held in Hanover, Germany in November 2001. However, the three transverse swinging arms and the cardan shaft driving the wheel are fully unprotected and therefore require a high degree of maintenance.

The objective of this invention is to provide a vehicle with a technically simple independent suspension for wheels mounted on a wheel support, which suspension protects the cardan shaft driving the wheels from harmful influences, and has a low unsprung mass.

In the invention, the wheel support extending to the gearbox, protects the cardan shaft between the output shaft of the gear and the wheel drive shaft from mechanical damage and harmful environmental influences. Since the length of the longitudinal swinging arms does not affect the length and width of the vehicle, longitudinal swinging arms longer than the transverse swinging arms may be used and longer spring travel can therefore be achieved, giving rise to a short overall length with trailing longitudinal swinging arms.

The integral design of the wheel support as a longitudinal swinging arm as specified in claim 2, provides a wheel suspension having a small number of components, simplifying maintenance.

The wheel support as specified in claim 3, provides a low unsprung mass for the longitudinal swing arm.

An advantageous embodiment of the invention consists in each longitudinal swinging arm being guided in its swivel plane at a certain distance from its point of articulation on the gearbox. By means of such guidance it is possible to reduce the loading of the gearbox considerably in the area of the point of articulation and of the hinge bolt and its mounting, since the guide absorbs most of the lateral forces acting on the wheels.

Technically simple guidance is achieved by means of a longitudinal guide which is arranged on the gearbox and which interacts with a slide that can be swivelled with the longitudinal swinging arm. Further appropriate measures regarding the arrangement and design of the guide are described in claims 6 to 8.

In order to minimize torque to be transmitted by the cardan shaft driving the wheel, and hence also the external dimensions of the cardan shaft itself, a reduction gear may be mounted in the wheel support according to the invention.

A shutter may be provided to facilitate inspection and repair of the brake. The brake disc of a wheel brake may be installed in the wheel support extension housing, the brake disc being arranged in the drive line behind the cardan shaft, and the brake saddle being able to be swivelled in and out of its active position with a shutter covering an opening in the wall of the wheel

support extension housing. Such an installation facilitates easy inspection and repair of the brake.

In the drawings which illustrate exemplary embodiments of the invention, where:

Fig.1 is a first embodiment of a wheel suspension with a longitudinal swinging arm guided in a straight guide, in a side elevation,

Fig. 2 is a plan view of the wheel suspension according to Fig. 1 from above,

Fig. 3 is a side view of a second embodiment of a wheel suspension with a longitudinal swinging arm guided by means of transverse swinging arms;

Fig. 4 is a plan view of the wheel suspension according to Fig. 3 from above;

Fig. 5 is a side view of a third embodiment of a wheel suspension with a reduction gear installed in the gearbox, in contrast to the embodiments shown in Figs. 1 to 4; and

Fig. 6 is a plan view of the wheel suspension according to Fig. 5.

Figs. 1 and 2 relate to a wheel suspension for a field tractor, of which only two gearboxes 1 and 2, combined to form one unit, are shown. The front gearbox 1 contains a driving gear; a differential gear 3 is housed in the rear gearbox 2 for driving the rear unarticulated wheels 4 of the vehicle. The driven shafts 5 of differential gear 3, extend from the right and left of gearbox 2.

Each swinging arm 16, of a pair of swinging arms 16 comprises a member 7, which member mounts a wheel support towards the free end thereof, and at the other end thereof is mounted pivotally on a shaft 6 in front of driven shafts 5, in the longitudinal direction of the vehicle, a respective one swing arm of the pair being mounted on either side of the gearbox 1.

The said wheel support houses not only bearings 9 for supporting wheel shaft 10, which in turn supports a wheel 4, but also a reduction gear 11, these components being of prior art and are not therefore shown in detail. A reduction gear 11 is required to reduce the relatively high speeds of driven shafts 5 to the low speeds of wheels 4 used in field tractors.

Compared to the predetermined gauge of the field tractor, the width of gearbox 2 is small. Since wheel bearings 9 are to be located as close to wheel 4 as possible, a cardan shaft 12 is used to transmit power from driven shaft 5 to reduction gear 11. The cardan shaft 12 equalizes the relative movements between the components resulting from movements of the vehicle. The arrangement of reduction gear 11 in wheel support 8 is such that the torque loading of cardan shaft 12 remains low because of its high speed and cardan shafts with small dimensions can be used.

To ensure that cardan shaft 12 is protected against undesirable environmental influences whilst the vehicle is operating, a wheel support extension housing, inside which cardan shaft 12 is securely housed, extends from wheel support 8 directly to gearbox 2. A slide 14, attached to wheel support extension housing 13 in the immediate vicinity of and parallel with gearbox 2 slides in a longitudinal guide 15 secured to gearbox 2. This relieves spring arm 7 and its shaft 6 of acting laterally on the wheels.

Webs 17, 18 provided between member 7 and wheel support extension housing 13, and between wheel support extension housing 13 and slide 14, stiffen the entire longitudinal swinging arm 16, consisting of member 7, wheel support 8, wheel support extension housing 13

and slide 14. Here web 17 serves as a support for a spring and damping element 19, which absorbs the spring excursion of longitudinal swinging arm 16, denoted by, and which is supported on a mounting surface 20 of gearbox 2.

The embodiment shown in Figs. 3 and 4 is distinguished, in terms of the wheel suspension itself, in that instead of a straight guide for longitudinal swinging arm 21, a transverse swinging arm 22, articulated between wheel support 8 and gearbox 25, is provided. Moreover, a spring leg 23 is arranged between wheel support extension housing 24 and gearbox 25.

Furthermore, a wheel disc brake is arranged in wheel support extension housing 24, where disc brake 26 lies in the drive line between cardan shaft 12 and reduction gear 11, and brake saddle 27 projects through an opening into wheel support extension housing 24 and is secured to a shutter 28 sealing the opening. Shutter 28 is mounted on wheel support extension housing 24 by means of hinges 29, and when swivelled outwards it enables the disc brake to be easily inspected.

The embodiment shown in Figs. 5 and 6 differs very little from the embodiments previously described in terms of the wheel suspension itself, except that reduction gear 30 is not assigned to wheel support extension housing 31 but to gearbox 32, the diameter of wheel support 33 may therefore be kept small. The part of gearbox 32 receiving reduction gear 30 is provided with a longitudinal guide 34 in which engages a slide 36 rigidly connected to member *35,* thereby providing a safe guide for longitudinal swinging arm 37. Longitudinal swinging arm 37 is suspended as described in Fig. 1, by means of a spring leg 38.